a first step of performing template matching between the registered template and a newly measured waveform; and

a second step of generating a new waveform template based on a plurality of waveforms further including the new signal waveform and replacing the registered template with the new template; and

wherein the first step and the second step are repeated sequentially.

9. (Amended) A pattern matching unit that performs template matching on a waveform of a signal, a value of the signal varying according to value change of at least a parameter, the pattern matching unit comprising:

a template generator which generates a waveform template including an expected value of a signal value at each value of the parameter and a probability template including a piece of occurrence probability information of the expected value at each value of the parameter based on the occurrence probability distribution of signal values for the respective values of the parameter, the distribution being estimated from a plurality of measured signal waveforms; and

a matching judgment unit which is electrically connected to the template generator and which performs template matching between a newly measured signal waveform and the waveform template by using pieces of occurrence probability information of the expected values as pieces of weight information at respective values of the parameter, the pieces of occurrence probability information composing the probability template.

11. (Amended) A pattern matching unit that performs template matching, comprising:

a template generator which generates a waveform template based on a plurality of measured signal waveforms and registers the generated template as a registered template; and

a matching judgment unit which is electrically connected to the template generator and which performs template matching between a newly measured signal waveform and the registered template; and

wherein the template generator generates a new waveform template based on the plurality of signal waveforms and the new signal waveform and replaces the registered template with the new template.

12. (Amended) A position detection method of detecting a position of a specific mark formed on a detected body, comprising:

a first measurement step of measuring a plurality of marks having almost the same shape as the specific mark, the marks being formed on the detected body;

a second measurement step of measuring the specific mark;

a pattern matching step of performing pattern matching through use of a pattern matching method according to claim 1, the pattern matching method using signal waveforms measured at the plurality of marks as a plurality of signal waveforms, a signal waveform measured at the specific mark as a new signal waveform, and positions as values of a parameter; and

a position detection step of obtaining positional information of the specific mark, based on the pattern matching results.

15. (Amended) A positional detector that detects a position of a specific mark formed on a detected body, comprising:

a measurement unit measuring the specific mark and a plurality of marks having almost the same shape as the specific mark, the marks being formed on the detected body;

a pattern matching unit according to claim 9, performing pattern matching by using signal waveforms measured at the plurality of marks as a plurality of signal waveforms, a

signal waveform measured at the specific mark as a new signal waveform, and positions as values of a parameter; and

a processing unit of obtaining positional information of the specific mark, based on the pattern matching results.

17. (Amended) An alignment method of aligning a detected body on which a first number of marks having almost the same shape as one another are formed, comprising:

a mark position detection step of detecting positional information of a second number of marks through use of a position detection method according to claim 12, by sequentially using as a specific mark each of the second number of marks selected from the first number of marks; and

an alignment step of aligning the detected body, based on the positional information of the second number of marks detected in the mark position detection step.

18. (Amended) An alignment unit that aligns a detected body on which a first number of marks having almost the same shape as one another are formed, comprising:

a position detector according to claim 15, detecting positional information of a second number of marks by sequentially using as a specific mark each of the second number of marks selected from the first number of marks; and

a position controller to align the detected body, based on the positional information of the second number of marks detected in the position detector.

19. (Amended) An exposure method of transferring a pattern formed on a mask onto divided areas on a substrate, comprising:

a divided area position detection step in which positional information of the divided areas on the substrate is obtained by detecting positional information, relative to the substrate, of a second number of alignment marks through use of a position detection method according

to claim 12 while sequentially using as a specific mark each of the second number of alignment marks selected from a first number of alignment marks that are formed on the substrate as a detected body and have almost the same shape as one another; and

a transferring step of transferring the pattern onto the divided areas while aligning the substrate based on the positional information of the divided areas on the substrate obtained in the divided area position detection step.

Please add new Claims 24-34 as follows:

24. (New) A positional detection method of detecting a position of a specific mark formed on a detected body, comprising:

measuring a plurality of marks having almost the same shape as the specific mark, the marks being formed on the detected body;

measuring the specific mark;

performing pattern matching through use of a pattern matching method according to claim 5, the pattern matching method using signal waveforms measured at the plurality of marks as a plurality of signal waveforms, a signal waveform measured at the specific mark as a new signal waveform, and positions as values of a parameter; and

obtaining positional information of the specific mark, based on the pattern matching results.

25. (New) The positional detection method according to claim 24, wherein the specific mark changes periodically in a first direction, and wherein values of the parameter are positions in the first direction.

26. (New) The positional detection method according to claim 25, wherein the specific mark also changes periodically in a second direction that is different from the first

direction, and wherein the parameter represents a two-dimensional position in a plane defined by the first and second directions.

27. (New) A positional detector that detects a position of a specific mark formed on a detected body, comprising:

a measurement unit measuring the specific mark and a plurality of marks having almost the same shape as the specific mark, the marks being formed on the detected body;

a pattern matching unit according to claim 11, performing pattern matching by using signal waveforms measured at the plurality of marks as a plurality of signal waveforms, a signal waveform measured at the specific mark as a new signal waveform, and positions as values of a parameter; and

a processing unit of obtaining positional information of the specific mark, based on the pattern matching results.

28. (New) The positional detector according to claim 27, wherein the measurement unit comprises a picking-up unit to pick up marks formed on the detected body, and the signal waveform is composed of changes, between positions, of a light intensity in a mark image picked up by the picking-up unit.

29. (New) An alignment method of aligning a detected body on which a first number of marks having almost the same shape as one another are formed, comprising:

detecting positional information of a second number of marks through use of a positional detection method according to claim 24, by sequentially using as a specific mark each of the second number of marks selected from the first number of marks; and

aligning the detected body, based on the positional information of the second number of marks detected in the mark positional information detection.

30. (New) An alignment unit that aligns a detected body on which a first number of marks having almost the same shape as one another are formed, comprising:

a position detector according to claim 27, detecting positional information of a second number of marks by sequentially using as a specific mark each of the second number of marks selected from the first number of marks; and

a position controller to align the detected body, based on the positional information of the second number of marks detected in the position detector.

31. (New) An exposure method of transferring a pattern formed on a mask onto divided areas on a substrate, comprising:

divided area position detection in which positional information of the divided areas on the substrate is obtained by detecting positional information, relative to the substrate, of a second number of alignment marks through use of a positional detection method according to claim 24 while sequentially using as a specific mark each of the second number of alignment marks selected from a first number of alignment marks that are formed on the substrate as a detected body and have almost the same shape as one another; and

transferring the pattern onto the divided areas while aligning the substrate based on the positional information of the divided areas on the substrate obtained in the divided area position detection.

32. (New) The exposure method according to claim 31, wherein the plurality of divided areas are arranged in a matrix-shape on the substrate, wherein the alignment mark comprises a third number of first alignment marks having almost the same shape as one another and a fourth number of second alignment marks having almost the same shape as one

another, the first and second alignment marks being used respectively for aligning in row direction of the matrix and for aligning in column direction of the matrix,

wherein in the divided area position detection, positional information, in the row direction on the substrate, of a fifth number of first alignment marks is obtained through use of a positional detection method according to claim 12 while sequentially using as a specific mark each of the fifth number of first alignment marks selected from the third number of first alignment marks, and also positional information, in the column direction on the substrate, of a sixth number of second alignment marks is obtained through use of a positional detection method according to claim 12 while sequentially using as a specific mark each of the sixth number of second alignment marks selected from the fourth number of second alignment marks, and wherein positional information, relative to the substrate, of the divided areas is obtained by statistically processing the positional information in the row direction of the fifth number of first alignment marks and the positional information in the column direction of the sixth number of second alignment marks.

33. (New) An exposure apparatus for transferring a pattern formed on a mask onto divided areas on a substrate, comprising:

a stage unit moving the substrate along a predetermined plane; and

a position detector according to claim 27, obtaining positional information of a second number of positional marks by sequentially using as a specific mark each of the second number of alignment marks selected from a first number of alignment marks that are formed on the substrate as a detected body and have almost the same shape as one another.

34. (New) A device manufacturing method including a lithography process, wherein in the lithography process, a predetermined pattern is transferred onto divided areas on a substrate according to an exposure method as recited in claim 31.

REMARKS

Favorable consideration of this application, as presently amended, is respectfully requested.

The present Preliminary Amendment is submitted to place the above-identified application in more proper format under United States practice. By the present Preliminary Amendment the claims have been amended to correct for minor informalities and to delete the multiple dependencies.

Further, the present Preliminary Amendment is submitted to present new Claims 24-34 for examination. New Claims 24-34 are deemed to be self-evident from the original disclosure, and thus are not deemed to raise any issues of new matter.

The present application is believed to be in condition for a full and thorough examination on the merits. An early and favorable consideration of the present application is hereby respectfully requested.

Respectfully submitted,

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IN THE CLAIMS

Claim 23 - (Cancelled)

Please amend the claims as follows.

--5. (Amended) A pattern matching method of performing template matching between a waveform template, as a registered template, generated [base] based on a plurality of measured signal waveforms and a subsequently measured signal waveform, comprising:

a first step of performing template matching between the registered template and a newly measured waveform; and

a second step of generating a new waveform template based on a plurality of waveforms further including the new signal waveform and replacing the registered template with the new template; and

wherein the first step and the second step are repeated sequentially.

9. (Amended) A pattern matching unit that performs template matching on a waveform of a signal, a value of the signal varying acqording to value change of at least a parameter, the pattern matching unit comprising:

a template generator which generates a waveform template including an expected value of a signal value at each value of the parameter and a probability template including a piece of occurrence probability information of the expected value at each value of the parameter based on the occurrence probability distribution of signal values for the respective

values of the parameter, the distribution being estimated from a plurality of measured signal waveforms; and

a matching judgment unit which is electrically connected to the template generator and which performs template matching between a newly measured signal waveform and the waveform template by using pieces of occurrence probability information of the expected values as pieces of weight information at respective values of the parameter, the pieces of occurrence probability information composing the probability template.

11. (Amended) A pattern matching unit that performs template matching, comprising:

a template generator which generates a waveform template based on a plurality of measured signal waveforms and registers the generated template as a registered template; and

a matching judgment unit which is electrically connected to the template generator and which performs template matching between a newly measured signal waveform and the [waveform] registered template; and

wherein the template generator generates a new waveform template based on the plurality of signal waveforms and the new signal waveform and replaces the registered template with the new template.

12. (Amended) A position detection method of detecting a position of a specific mark formed on a detected body, comprising:

a first measurement step of measuring a plurality of marks having almost the same shape as the specific mark, the marks being formed on the detected body;

a second measurement step of measuring the specific mark;

a pattern matching step of performing pattern matching through use of a pattern matching method according to [any of the claims] 1 [to 8], the pattern matching method using

signal waveforms measured at the plurality of marks as a plurality of signal waveforms, a signal waveform measured at the specific mark as a new signal waveform, and positions as values of a parameter; and

a position detection step of obtaining positional information of the specific mark, based on the pattern matching results.

15. (Amended) A positional detector that detects a position of a specific mark formed on a detected body, comprising:

a measurement unit measuring the specific mark and a plurality of marks having almost the same shape as the specific mark, the marks being formed on the detected body;

a pattern matching unit according to [any of the claims] claim 9 [to 11], performing pattern matching by using signal waveforms measured at the plurality of marks as a plurality of signal waveforms, a signal waveform measured at the specific mark as a new signal waveform, and positions as values of a parameter; and

a processing unit of obtaining positional information of the specific mark, based on the pattern matching results.

17. (Amended) [A] An alignment method of aligning a detected body on which a first number of marks having almost the same shape as one another are formed, comprising:

a mark position detection step of detecting positional information of a second number of marks through use of a position detection method according to claim 12, by sequentially using as a specific mark each of the second number of marks selected from the first number of marks; and

[a] an alignment step of aligning the detected body, based on the positional information of the second number of marks detected in the mark position detection step.

18. (Amended) [A] An alignment unit that aligns a detected body on which a first number of marks having almost the same shape as one another are formed, comprising:

a position detector according to claim 15, detecting positional information of a second number of marks by sequentially using as a specific mark each of the second number of marks selected from the first number of marks; and

a position controller to align the detected body, based on the positional information of the second number of marks detected in the position detector.

19. (Amended) [A] An exposure method of transferring a pattern formed on a mask onto divided areas on a substrate, comprising:

a divided area position detection step in which positional information of the divided areas on the substrate is obtained by detecting positional information, relative to the substrate, of a second number of alignment marks through use of a position detection method according to claim 12 while sequentially using as a specific mark each of the second number of alignment marks selected from a first number of alignment marks that are formed on the substrate as a detected body and have almost the same shape as one another; and

a transferring step of transferring the pattern onto the divided areas while aligning the substrate based on the positional information of the divided areas on the substrate obtained in the divided area position detection step.--

Claims 24-34 (New).

DESCRIPTION

PATTERN MATCHING METHOD AND UNIT, POSITION DETECTION METHOD AND UNIT, ALIGNMENT METHOD AND UNIT, EXPOSURE METHOD AND APPARATUS, AND DEVICE AND DEVICE MANUFACTURING METHOD

TECHNICAL FIELD

The present invention relates to a pattern matching method and unit, a position detection method and unit, a alignment method and unit, an exposure method and apparatus, and a device and its manufacturing method, and more specifically to a pattern matching method and pattern matching unit using a template generated from actually measured signal waveforms, a position detection method and positional detector to detect the position of a body to be detected on the basis of results of performing pattern matching on a new signal waveform through use of the pattern matching method, a alignment method and unit to align the detected body on the basis of results of detecting the position of the detected body through use of the position detection method, an exposure method and exposure apparatus to transfer a pattern onto a substrate while aligning the substrate through use of the alignment method, and a device manufactured by using the exposure method and its manufacturing method.

BACKGROUND ART

In a lithography process for manufacturing a

semiconductor element, liquid crystal display element, or the like, an exposure apparatus has been used which transfers a pattern formed on a mask or reticle (to be generically referred to as a "reticle" hereinafter) onto a substrate such as a wafer or glass plate (to be referred to as a "wafer" hereinafter) through a projection optical system. As such an exposure apparatus, a stationary-exposure-type projection exposure apparatus such as the so-called stepper, or a scanning-exposure-type projection exposure apparatus such as the so-called scanning stepper is mainly used.

In such an exposure apparatus, it is necessary to perform highly accurate alignment between the reticle and wafer before exposure. To perform this alignment, because a position detection mark (alignment mark) that is formed (transferred) in the previous photolithography process is provide on each shot area on the wafer, by detecting this alignment mark, the position of the wafer (or a circuit pattern on the wafer) can be detected. And on the basis of the detection result of the position of the wafer (or a circuit pattern on the wafer), the alignment is performed.

Therefore, the accuracy of alignment is determined by the accuracy of detecting the position of the alignment mark. Accordingly, to perform the alignment with high accuracy, it is necessary to detect the position of the alignment mark with high accuracy.

Several methods of detecting the position of an